gel provides primary amine functional groups for the subsequent attachment of specific binding entities. This type of gel permeation layer allows the electrodes to function actively in the DC mode. When the electrode is activated, the gel permeation layer allows small counter-ions to pass through it, but the larger specific binding entity molecules are concentrated on the outer surface. Here they become covalently bonded to the outer layer of primary amines, which effectively becomes the attachment layer.

An alternative technique for the formation of the permeation and attachment layers is to incorporate into the base of each micro-location chamber a porous membrane material. The outer surface of the membrane is then derivatized with chemical functional groups to form the attachment layer. Appropriate techniques and materials for carrying out this approach are known to those skilled in the art.

The above descriptions for the design and fabrication of both the microlithographic and micromachined devices should not be considered as a limit to other variations or forms of the basic device. Many variations of the device with larger or smaller numbers of addressable micro-locations or combinations of devices can be for different analytical and preparative applications. Variations of the device with larger addressable locations can be designed for preparative biopolymer synthesis applications, sample preparation, cell sorting systems, in-situ hybridization, reagent dispensers, storage systems, and waste disposal systems.

## II. SELF-DIRECTED ADDRESSING OF THE DEVICES

The following oligomers contained a 5'-amino termini:

| | |
|---|---|
| ET-21A | 5'-Amino-TGC GAG CTG CAG TCA GAC AT |
| ET-10AL | 5'-Amino-GAG AGA CTC ATG AGC AGG |
| ET-11AL | 5'-Amino-CCT GCT CAT GAG TCT CTC |
| T-2 | 5'-Amino-TTT TTT TTT TTT TTT TTT T |
| RC-A1 | 5'-Amino-CAG GCA GTC TCC TTC CTC TCC AGG TCC ACG TAG |
| RC-A2 | 5'-Amino-CTC CAA ATT TGC TGA ACT C |
| RC-A3 | 5'-Amino-GGA GAT GAG GAG TTC TAC G |
| RC-A4 | 5'-Amino-CTG GAG AGG AAG GAG AC |
| RC-A5 | 5'-Amino-CCA CGT AGA ACT GCT CAT C |
| RC-A6 | 5'-Amino-GTC TCC TTC TTC TCC AG |
| RC-A7 | 5'-Amino-GTC AAA TCT AAG TCT GTG GAA |
| RC-A8 | 5'-Amino-ATC TTC TAA ATC TGC GGA A |
| RC-A9 | 5'-Amino-GTC TGA GAA CAG GCA AAC A |
| RC-A10 | 5'-Amino-ATG TTT TGT CAC AGC GAT G |

EXAMPLE 2: Electronically Addressable Micro-locations on a Microfabricated Test Device - Polylysine Method

Micro-locations were fabricated from microcapillary tubes (0.2 mm x 5 mm). The microcapillaries were filled with 18-26% polyacrylamide containing 0.1 - 1.0% polylysine and allowed to polymerize. The excess capillary was scored and removed to prevent air bubbles from being trapped within the tubes and to standardize the tube length. Capillaries were mounted in a manner such that they shared a common upper buffer reservoir and had individual lower buffer reservoirs. Each lower buffer reservoir contained a platinum wire electrode.

The top surface of the microcapillary in the upper reservoir was considered to be the addressable micro-location. The upper and lower reservoirs were filled with 0.1 M sodium phosphate, pH 7.4 and pre-run for 10 minutes

The particles are stored as a 2% suspension in distilled water. An aliquot of 25 to 50 µl of the 0.02 - 1.0 µm amine modified red fluorescent Fluospheres was pelleted and re-suspended in 0.1M sodium phosphate, pH 7.4. An excess of periodate oxidized poly ribo-A was added to the suspension. The reaction was allowed to incubate for 90 minutes at room temperature. The particles were washed and pelleted several times in 1x SSC, 0.1% SDS (0.15 mM sodium chloride, 0.015 mM sodium citrate, 0.1% (w/v) sodium docecyl sulfate, pH 7.0) to remove unbound and non-specifically bound poly ribo-A.

The DNA-fluorospheres in buffered solution were placed in a direct current electric field. It was observed that the DNA-Fluorospheres migrated towards the positive electrode, indicating that their net charge was now negative. This is a simple and convenient method to determine if the DNA coupling reaction was successful. Traditional hybridization methods would require using a radiolabeled reporter probe because the intense fluorescence from the particles would obscure any hybridization signal.

3) DNA Attachment to Test Devices

The test devices were polymerized with highly cross-linked polyacrylamide, containing 1% succinimidyl acrylate, which can be subsequently reacted with 5'-amine terminated DNA probes. The attachment of the capture sequence, oligo-T, was verified by hybridization with fluorescently labeled complement probe, CP-1-TR. The test device surfaces were highly fluorescent which indicates that the surface was derivatized with capture sequences.

selector unit can now be used to transport the crude nucleic acid (DNA/RNA) materials to this component.

The crude DNA selector is an APEX device which has a general affinity for DNA. This affinity can be a positively charged surface, or a surface which contains a common or repetitive DNA sequence. For example, an Alu repeat capture sequence would effectively capture most of the crude DNA extracted from human cells. A common or generic bacteria or viral sequence could be used when infectious disease analysis is the objective. In addition to removing extraneous materials from the DNA; the APEX system is also designed to reduce the complexity of the sample DNA. This can be achieved by using restriction enzymes to selectively cleave the DNA at the crude DNA selector unit. The restriction enzymes are transported from the reagent dispenser unit. The cleaved restriction fragments can now be transported from to the secondary DNA or restriction fragment selector unit by biasing it positive. This unit is designed to selectively bind large fragments of DNA, using appropriate capture sequences on its surface.

At this point, selected DNA fragments can be transported to the APEX analytical chip for hybridization analysis. It is also possible to transport DNA fragments to the storage unit or even out of the system. The examples above represent just some of the possible scenarios for sample preparation and multiple hybridization analysis. The binding affinity programmability of components and flexibility of combining different components and functions allows a wide variety of procedures to be carried out.

While DNA is used as a primary example, the above described device and method can also be used for the